Assimilation theory: a pretty tale

Abstract

This is a lighthearted look at how assimilation and contrast are involved in perception at increasing levels of complexity ranging from foraging for food to the perception of pictures. As an example of the latter, the operation used to produce the Craig-O’Brien-Cornsweet illusion, is followed to generate a geometric illusion of size (the bedroom lamp illusion) that is nothing more that a variant of the classical Müller-Lyer and Ponzo illusions. The contention that these classical geometric illusions are due to assimilation is thus supported.

Greetings friend,

You should never tempt one who has spent his entire career trying to understand perceptual quirks to expound on them. Like a fervent crusader, he will spend hours saving you from dens of iniquity, which house naught but misguided thought.

What you have asked me to comment on is known as the Craik-O’Brien-Cornsweet illusion\(^1\). So, here is the first thing you should do. Take a white sheet of paper and cut out small apertures (diamonds are easiest) so that you are sampling the top part of the upper portion and the bottom part of the bottom portion. Next, place the paper over the picture and observe the two grey colours. They are indistinguishable.

![Figure 1. The Craik-O’Brien-Cornsweet illusion in which the grey portion near the upper part of the solid object is equal to the grey portion near the lowest part of that object.](image)

What is going on here? The answer is very simple. You are tapping into one, or both, of two primitive programs in your brain. One is called “assimilation” and the other is called “contrast” both of which allow us to deal with the world out there as
if were filled with "things" or "objects" and not with amorphous stimuli. As William James so beautifully put it, our conscious world is not a "blooming, buzzing confusion".

But a "thing" cannot be a "thing-by-itself". It can only be a thing if it is one sample of similar things. Thus, the reason that one sees a cloud in the sky as the face of Mona Lisa is the same reason that an image of Jesus appears on a slice of toast. The brain "chunks" stuff into what we call "concepts" in order to deal effectively (or adaptively, or rationally) with a physical world of impossible complexity. One way that it does so is by means of what I, and others, call "assimilation".

But I am getting much too analytic here and, in my former life, students had much difficulty with this notion. And so I concocted a little story, a secular parable so to speak, to illustrate the argument. This pretty story goes like this:

Imagine a primitive bird whose habitat is on the beaches of the Mediterranean Sea and whose survival depends upon einkorn wheat which, when it ripens, falls upon and becomes mixed with the grains of sand. When this raptor spies sustenance ("food" in everyday language), it begins to peck. But, here is the problem. Each grain, just like a snowflake, is a unique gestalt of shape, size, colour, texture and other attributes so that, if it had to choose which feature was the defining characteristic of wheat, it would never be able to decide. Like Buridan’s ass, it would starve from indecisiveness. But, because of assimilation (pooling,

![Image](image1.png)

**Figure 2.** My pretty tale has a long history (see Pressey's Pieces—Illusions are adaptive). Unfortunately, even my best students sometimes didn't quite get the point. The story doesn't work very well with grain falling on grass!
lumping, averaging, leveling, entropy) each individual kernel, in consciousness, takes on the properties of every other kernel, which is one way of saying that it responds on the basis of a concept and not to any one of an infinite number of features.

But we are not finished. We are only half way in describing the life of our hungry creature.

If the concept of “wheat” is too broad, too inclusive, grains of sand along with the einkorn will be ingested inadvertently. Indeed, if the intake of sand exceeds the intake of grain, the amount of food that is ingested will be insufficient to sustain our little friend. Therefore, there must be a second process, one that provides boundaries to assimilation. It must segregate or differentiate between objects. This process we call contrast. Thus, a grain of sand that is too black or too big will trigger, in consciousness, an accentuation of the difference so that the categories of “grain” and “sand” are seen as different things and, therefore, change the way it behaves.

The main reason that illusions, such as the one you mentioned, are important is because they provide examples of how the brain levels the differences within objects and sharpens the differences between objects. Moreover, because these effects can be measured, we have, in a study of these phenomena, the seeds of a science of consciousness.

As I think about this tale of mine, several ideas come to mind—ideas that are weird but, because sometimes weird is good, I will mention two of these.

I have always been intrigued by the fact that birds have gizzards to digest food. Stones and sand grind hard seeds into nutrients, which then can be more easily absorbed. Is it possible that the reason for this peculiar biological development is captured in the above scenario? It sounds plausible but look what it would mean. It would imply that conscious experience guided the development of anatomy and not the other way around which is what our intuition has always told us. Ah Bob, that is why speculating about evolution is even more fun that engaging in Freudian psychoanalysis. To become an intellectual giant, one need not do the best science but only spin the best yarns.

The second fascinating idea, or question, that our little einkorn-eating biped prompts us to consider is how exactly assimilation works. Specifically, is it an active process such as, perhaps, a cognitive calculation of an average or is it just a failure to see a difference. To put it another way—with only one brain cell no calculation could occur so every message from that cell would signal identity.

An example of passive sameness is provided by the notion of entropy², a word I included above to connote sameness. Entropy refers to a state of maximum disorder and is often considered in the context thermodynamics.

Please humour me for a moment and join in the following thought experiment: Into a container that is a perfectly closed system (an impossible state, in reality) insert metal bars with temperatures of 5°, 10°, 15°, 20° and 25°. Allow them to simply sit there for a prolonged time. Eventually, the temperature of everything in that container will be the same. To my mind, this is an excellent example of how a non-directed move toward sameness can occur. But now consider a similar example in the realm of conscious experience. Instead of the metal bars,
draw a series of 5 lines ranging from 5mm to 25mm in steps of 5mm. Next, ask an
observer to judge the size of the lines. You will find that the small line will appear to
be too big and the big line will appear to be too small. Both lines, in consciousness,
have regressed toward the average and look like each other— an entropic event. But,
unlike the heated bars, one never reaches a state where all lines appear to be exactly
the same. What this means is that intelligent systems are systems that are geared to
preventing maximum sameness and maintaining some distinction.

All of this brings me to a final conclusion. In sentient beings, higher and
higher levels of cognitive abilities are the result of higher and higher capacities to
make distinctions, an idea that has been incubating since my days in Saskatchewan
where we first met. In our research, we found that atypical groups exhibited less
distortion on tasks involving contrast but greater distortion on tasks involving
assimilation. Including too much in a category apparently reduces smartness.
Perhaps this is the “g” factor that has so engrossed psychometrists in the past.
Now, definitely, I have said too much!

Please allow an old curmudgeon to repeat a complaint. Discussions of
 illusions always attempt to evoke an aura of golly-wow-gee-whizz magic and the
admonition to be wary of how badly eyes can deceive. I have tried to convince you
that this is callow metaphysics. If we responded to the "real" nature of the grain of
wheat or the "real" nature of the snowflake we would be like Buridan’s ass. Oops no,
I stand corrected! We would never have reached the intellectual height of an ass
because we would not have survived our first step out of the primordial slime!

Cheers,
Alexander

P.S. I never did explain the Craik-O’Brien-Cornsweet effect. The first fact to
note is that the picture consists of two portions of a figure that is contrasted from
the background. Within each portion, there are gradients of darkness. In the lower
portion the gradient is from dark at the bottom to light on top and in the upper part,
one again, the gradient is from dark at the bottom to light at the top. But near the
upper and lower edges the luminance (hence greyness) is the same, which is what
you see in the apertures of the mask that I asked you to construct. But why does the
bottom portion look white whereas the upper one looks dark? Because of leveling
within each part, the average grey the bottom is lighter than the average grey on top
and that is what you see.

As I analyzed the effect in this manner, it struck me that the same argument
should hold not just for attributes such as luminance but for others as well. Since my
scientific efforts have focused mainly on the feature of size, I drew a graded series of
lines differing in size following the recipe provided by the Craik-O’Brien-Cornsweet
effect. The result was a new geometric illusion that, for now, we can call “the
bedroom lamp illusion”. It is illustrated in the picture on the left below. Here the
line on top appears longer than the line below. If you construct a mask with
apertures that expose only the upper and the lower lines, you will notice that they
are identical. Moreover, notice that the average size of the stem is much smaller
than the average size of the shade thus mimicking again what is found in the Craik-
O'Brien-Cornsweet phenomenon. Also notice that, if one exchanges the horizontal lines for lines whose slopes are determined by the endpoints of those horizontal lines, clearly we have a variant composed of the old Müller-Lyer and Ponzo illusions—the pictures that first piqued the interest of philosophers of mind.

Interesting questions can now be asked. For example, are these classical geometric illusions explicable at the peripheral sensory level or is the Craik-O'Brien-Cornsweet phenomenon a higher-level cognitive effect? Or could it be that the same laws apply to phenomena at different levels of complexity from the behaviour of subatomic particles to the behaviour of conscious minds. As for me, I favour the last option most and the first option least. Exotic ideas appeal because they mute the jaded tone of one’s declining years.

Notes
1http://www.slate.com/blogs/bad_astronomy/2013/12/07/optical_illusion_shades_of_grey.html

2There I go again—dabbling in faux physics!

Alexander Pressey
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